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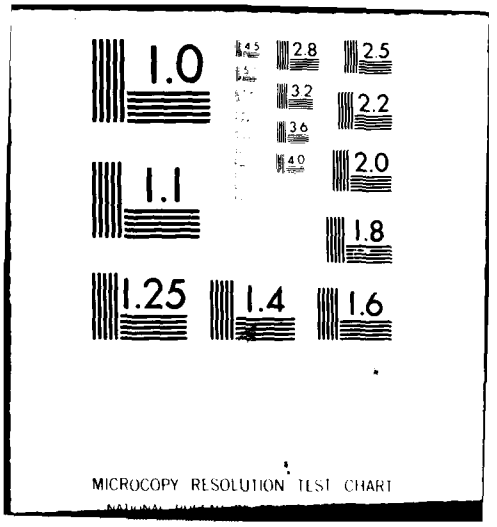
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The Military Message Experiment (MME) was designed to evaluate the utility of user-oriented message processing systems in a military environment and to aid in determining the features useful in such a system. The experiment is a cooperative effort between the Commander-in-Chief, Pacific, the Navy, and the Defense Advanced Research Projects Agency. To conduct the experiment, a PDP-10-based system was installed at CINCPAC Headquarters for use by a portion of the Operations Directorate. The message processing functionality was provided by SIGMA, a program written by the Information Sciences Institute of the University of Southern California. It was supported by the

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20. Abstract (Continued)

TENEX operating system, and the user terminals were modified HP-2649A CRTs.

The MME system was designed to give the user the capability to handle his message traffic (both incoming and outgoing, formal and informal) on the system. The system enforced multilevel security rules based on a modification of the security kernel model developed at Mitre. The rule enforcement was not rigorous enough for certification, but it was sufficiently rigorous to determine the effects on the users' interactions with the system. Most of the functions needed for a user's message-related tasks were provided by the system: message distribution and redistribution, "electronic readboard" construction, message filing, message replies, message commenting and "chopping," and message release.

This report evaluates the MME system from the user's viewpoint. The CINCPAC recommendations concerning future automated message-handling systems are:

a. An automated system must be reliable, readily available to all who need to use it, responsive, compatible with other message-handling equipment, and interoperable with its support message-transmission system.

b. It must be designed and fielded with the close participation of the user community.

c. The benefits to be realized from an automated message-handling system are not of such overriding operational significance as to require the fielding of an interim system that does not meet the user's needs.

CONTENTS

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1. Introduction. This section of the MME Final Report will cover the period from April 1979 through the end of the experiment in September 1979. It will discuss the daily users' perceptions, the simulated CPX, a variety of issues that were not included in the final MME questionnaire but are deemed to be significant to the goals of the experiment, and recommendations concerning automated message handling.

2. Daily Users' Perceptions.

a. During the final months of the MME, the system reliability increased, and various enhancements were made to the software which inproved performance and made the system more beneficial to the user. The overall feeling of most users toward the system improved. Especially noteworthy were the attitudes of newly-arrived personnel who had not gone through the system's earlier growing pains; they were very satisfied with it and had a positive feeling toward automated message handling as a result of their brief exposure to SIGMA.

b. The final MME questionnaire was concerned with user views on automated message handling, independent of the type of system to be used. It was assumed in the questionnaire that system reliability and ease of access to a terminal would not be a problem. Fifty-three questionnaires were distributed, with 38 responses. For each of the major message-handling categories listed, the users were asked various questions including whether they would prefer doing that function with an automated system (fully reliable and easily accessable) or a manual system. Not all respondents answered the questions in every category, as their duty positions determined how they used the system. Table 1 summarizes the respondents' preferences for automated or manual message handling.

c. The user comments on automated versus manual message handling were much more positive than those in the questionnaire prepared in March 1979 for the Mid-Experiment Report. Proponents of the manual system maintain that doing a particular function manually is "faster" or "easier" or provides "more control, more flexibility, and more selectivity," or has "less chance of error." These are the identical reasons that other users gave for preferring automated message handling.

d. As indicated in Table 1, the message-handling function which has the least support for automation is message review. Even having

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Table 1

Function	Prefer Automated	Prefer Manual	% Prefer Automated
MESSAGE DISTRIBUTION	17	2	89
MESSAGE REVIEW	21	11	66
MESSAGE FILING	25	1	96
MESSAGE RETRIEVAL	32	3	91
MESSAGE CREATION	22	2	92
MESSAGE COORDINATION	14	2	88
MESSAGE RELEASE	8	1	89

experienced the improved system reliability and performance during the last months of the MME, one-third of the users still prefer the concept of reading messages on a paper copy. (This does not take into consideration the amount of effort required to have a set of selected messages in an action officer's in-box upon his arrival in the morning.) Reasons mentioned for preferring a manual system include the ability to determine rapidly if the message needs to be read at all, the ease of scanning the entire message or skipping back to recheck a portion of a long message, the speed of getting the next message, and the proven reliability of the paper system.

e. Of the three broad message-handling categories (incoming message processing, message filing and retrieval, and outgoing message processing), the users showed the greatest preference for message filing and retrieval (Table 1). This is consistent with the user preferences reflected in the Mid-Experiment Report questionnaires. Informal discussions with users and the comments on the final questionnaire indicated that the message filing and retrieval capability would be the one most missed upon termination of the MME.

f. The users showed a strong preference for the concept of automated support for the outgoing message process (message creation, editing, coordination, and release). The release function was significantly improved with SIGMA release 2.23 (April 1979), which may account in some part for the favorable change in user perceptions of automated processing of outgoing messages.

3. Simulated Exercise One of the primary goals of the MME was to determine the usefulness of automated message handling in a crisis situation.

a. The MME system was used during Exercise Power Play in March 1979 as a backup message-handling system. Because of low system reliability, low message influx, and its backup role, no determination could be made as to the usefulness of an automated message-handling system in a crisis (or exercise) situation. A more detailed report on use of the MME system during Exercise Power Play is contained in the Mid-Experiment Report.

b. In order to attempt the determination of automated message handling usefulness in a crisis/exercise situation, a simulated Command Post Exercise (SCPX) was conducted in September 1979. The SCPX was based on Exercise Power Play 79 (PP-79), as all incoming PP-79 messages had been retained in the MME archives.

c. The concept of the SCPX was to use the MME system as the only message-handling medium for the Operations Action Group (OAG), which is the CINCPAC Crisis Action Team formed to coordinate CINCPAC actions during a crisis or exercise situation. (A detailed description of the OAG is in the Mid-Experiment Report.) A controller would inject the

incoming messages into SIGMA; the injection rate could be varied to simulate the normal peaks and valleys of message arrival. Each OAG member had his own terminal and working area in the OAG room. A printer was also available in the OAG room.

d. The message distribution play for the SCPX differed from that of PP-79 as described below.

(1) In PP-79, SIGMA sent all incoming messages to the OAG XO, who reviewed each message, made distribution, and assigned action as appropriate. The XO also maintained the Status of Action Log and the Significant Events Log.

(2) In the SCPX, SIGMA filed all messages in the master message file, to which all OAG members had access, and forwarded all messages to the XO. The only requirements for the XO were to review the incoming messages and assign action on them as appropriate, and to select items for the Significant Events Log (SEL).

e. The Assistant XO (AXO, not a player during PP-79) monitored the SEL and added comments to each item filed in it by the XO so that any player could look at the SEL and see a synopsis of the significant events without having to display the message itself. The player had the ability to display and read the entire message if he so desired. Thus someone could monitor the progress of the crisis/exercise on a terminal in his office without having to go to the Command Center (OAG location).

f. The AXO also monitored the Status of Action Log (SAL). SIGMA automatically filed a citation in the SAL for every message assigned for action by the XO, as well as in the action officer's pending file. When an action officer completed work on a particular message or set of messages, he would make an appropriate comment on the citation(s) in the SAL (to which all players had access). Periodically, the AXO would review the SAL and transfer all completed actions to the Action Completed file. Thus, the SAL contained only those messages on which action was being taken or had been recently completed.

g. Action officers were expected to perform as much of their message-handling functions as possible using the terminal, but were free to use the printer as they desired. Each action officer was expected to review the master file on a periodic basis for messages relating to his functional area. Each action officer's Alert-Selector contained, as a minimum, For-Action, so that an action citation from the XO would come to the immediate attention of the action officer. An action officer could retain messages of interest to him by either marking the message with a Keyword of his choosing or by creating appropriate files for various messages. Both methods were used during the SCPX.

h. Action officers created outgoing messages and coordinated them within the OAG as required. The message was then sent to the XO, who

checked it and simulated its release by sending it to the controller. The controller double-checked the message, then released it to the LDMX, which provided the drafter a back-copy through SIGMA.

i. The daily CINCPAC Situation Report (SITREP) was prepared in the following manner:

(1) Each action officer prepared his portion of the SITREP in a Text Object name Jx-SITREP-INPUT (where the x represents the action officer's OAG code).

(2) When an action officer had finished his portion of the SITREP, the J31 representative, who was responsible for the overall SITREP preparation, would GET the text object, VIEW it and COPY the text into the appropriate portion of the In-Preparation SITREP.

(3) Once the SITREP was completed, it was processed in the same manner as any other outgoing message.

j. The SCPX demonstrated that an automated message-handling system as represented by SIGMA is usable in a crisis/exercise situation. The SCPX players were able to keep up with the incoming message flow (the maximum rate of message input was 30 per hour). They were able to file and retrieve messages in a timely manner. They were able to draft, coordinate, and release outgoing messages, including the SITREP. The backup system devised by the MME staff to provide support in the unlikely event of system failure worked satisfactorily. However, the SCPX did not demonstrate that an automated message-handling system (as represented by SIGMA) is more efficient or effective than a manual system in a crisis/exercise, based on the following indicators concerning speed of message processing and quality of outgoing messages.

(1) Message Receipt. Messages arrived at each player's terminal during the SCPX in a rapid manner, regardless of precedence. During PP-79, messages of Immediate and higher precedence were delivered by the manual system to the XO as fast or faster than by SIGMA. SIGMA delivered Priority and Routine messages to the XO about 30 minutes ahead of the manual system. (The difference is due to the LDMX sending high-precedence messages directly to a line printer in the Command Center.) A principal advantage of an automated system would be the capability to distribute messages selectively to each OAG member, thus relieving him of the need to sort through all the messages to find the ones of interest to him. SIGMA's capability for user-created selectors is a major step in this direction; unfortunately, the loose standards for the format of a military message do not allow SIGMA to satisfy this message-selection requirement completely. Thus, both the manual and automated systems delivered messages to the OAG in a timely manner (considering the message precedence) and in sufficient quantity. The rapid delivery of messages by an automated system may be offset by the ability of a user to scan paper copies more rapidly than the automated system can display them.

(2) Message Filing and Retrieval. In the manual system, the OAG clerk maintains a master file of all incoming and outgoing messages, generally in time-of-arrival/time-of-dispatch sequence. SIGMA delivered all messages (incoming and back copies of outgoing) to the master file in time-of-arrival (at SIGMA) order. Since in the manual system each OAG member receives a copy of each message, he can create files by subject, originator, etc. (extra copies of paper messages are easily reproduced in the Command Center). SIGMA allows the creation of files by each user and also allows each user to mark messages in his copy of the master file by keyword. The major advantage of the automated system is the capability for retrieval of messages on multiple parameters, such as user-assigned keywords, subject, originator, date-time group, or any combination thereof. Another advantage is that each user has ready access, through the date files, to any previous message concerning his area of interest, even if the message arrived prior to the recognition that a crisis was impending or the start of an exercise. However, unless the user makes a paper copy of each message he needs for reference when composing an outgoing message, he can VIEW only one reference at a time while displaying the In-Preparation message. This makes it awkward if there are several messages to which a user needs to refer in composing his outgoing message. Overall user preference is for automated filing and retrieval, especially if a printer is readily available for production of hard copies of messages.

(3) Message Preparation, Coordination, and Release. SIGMA provided a good capability for the preparation of outgoing messages, especially for users with adequate typing skills.

(a) Users did not have to compete for the services of the OAG clerk-typist when more than one outgoing message needed to be typed, as has been the case in the manual system. The capability of copying sections of text from an object in the view window to the In-Preparation message was very helpful, especially in composing a SITREP.

(b) Coordination of an outgoing message within the OAG was an easy process in both systems. If a message needed to be coordinated outside the OAG, the advantage of the automated system increased as the distance of the coordinator from the Command Center increased. However, if there were off-line references required by the coordinator, the speed advantage of the automated system was lost. The great majority of OAG messages do not require coordination outside the Command Center; thus, manual coordination does not lag appreciably behind the automated system, especially if off-line references must be obtained anyway.

(c) Once a message is approved for release, SIGMA will get it to the LDMX for release to the AUTODIN network faster than the manual system. Manual messages are sent by pneumatic tube from the Command Center to the Communications Center. The manual message must then be read by the OCR equipment and, if accepted, processed by the LDMX and released to AUTODIN.

(d) A great advantage of SIGMA was the capability to readdress messages and release them rapidly. This was one of the most appreciated features of the automated system.

(4) Quality of OAG Product. A hypothesis was made by one of the SCPX evaluators that, if an automated message-handling system were to have military utility, it would have to process messages faster and/or contribute to a better quality output. The determination of the relative quality of OAG output between PP-79 and the SCPX would require a very subjective judgment as to which of the outgoing messages (PP-79 vs. SCPX) in response to a particular event was "better," however "better" might be defined. Even if a determination of quality were made, it would be difficult to ascribe the difference in quality solely to the assistance of the automated message-handling system because of the widely differing circumstances under which the messages were produced, e.g., different players producing the messages. Thus, any conclusion with regard to the military utility of an automated message-handling system based on the comparative quality of outgoing messages would have doubtful validity at best.

(5) Summary. Comparison of message handling in PP-79 (manual) and the SCPX is inconclusive in determining if an automated system is more effective or efficient than a manual system.

(a) Messages arrived at the OAG slightly faster in the manual system for high precedence traffic and much faster by the automated system for low precedence traffic; however, both systems delivered all messages in time to meet the needs of the players.

(b) Both systems provided a satisfactory message filing and retrieval system. The automated system was faster in retrieving messages that were received prior to the OAG's convening. Depending upon the way the files were set up, a particular message could be found as quickly in the manual system as in the automated system.

(c) The automated system was faster for creating outgoing messages, especially if the user was an adequate typist, and for readdressals. Coordination required about the same time in both systems. Release is faster by the automated system. All outgoing messages were processed satisfactorily by both systems.

(d) No valid comparison of the quality of outgoing messages produced by the manual and automated systems can be made.

4. Miscellaneous Issues. The system designers raised some issues concerning various aspects of automated message-handling systems which were not addressed in the questionnaires completed by the users. This section will cover these issues based on discussions with users and germane user comments in the questionnaires.

a. Training.

(1) One of SIGMA's features was on-line assistance and training, consisting of feedback to the user when SIGMA could not execute an instruction, the PROMPT facility, the HELP facility, and the LESSON/EXERCISE facility. The MME staff included a full-time trainer, who conducted periodic Introductory Lectures, more advanced training as requested, special classes prior to certain scheduled MME events, e.g., the Simulated CPX, and who provided on-call assistance when users were unable to perform a desired task. In addition, there was a trainer in J34 whose job was to ensure that each user was capable of operating the system at a given level of competence for his style of use (action officer, J301, Air Desk, etc.). However, the J3 trainer departed in mid-April 1979 and her replacement did not assume the MME training function.

(2) The users were widely divergent in their views concerning initial training. Some favored formal instruction, some peer training, some self-training. Most indicated that early "hands-on" experience was valuable in becoming familiar and comfortable with the system, especially for those who had not previously interacted with a terminal. Since the MME system was not used as an exclusive message-handling system within J3, there was no demand for everyone involved in message handling to become proficient in a short period of time and to maintain or improve their skills. Those who were interested in using the system achieved a high degree of proficiency and developed their own "tricks of the trade" to make the system perform for them. Those with low interest learned just enough to be able to "get by." For example, some Air Desk officers, in building the Readboard (a daily collection of messages deemed to be of particular interest to the J3), would look at each message in the Pending file in sequence, either filing it in the Readboard and then deleting it from the Pending file, or just deleting it. Others would use Selectors, the Route instruction, and other more sophisticated techniques to build the Readboard in much less time than the straightforward, one-message-at-a-time method.

(3) The users did not find PROMPT to be of much use. The major complaints about PROMPT were that it was not specific enough and that it did not give an actual example of the type instruction for which the user was seeking assistance. This may have been a training problem, as most users did not realize that if PROMPT gave them several options for an ambiguous instruction, they could select one of the options and receive a more detailed explanation of that particular instruction form. Also, most users probably did not really understand that SIGMA's interpretation of an instruction was situation-dependent, so that the same partial instruction could be interpreted differently, depending on the user's current state.

(4) The users also did not find HELP to be of much use. Using it appeared complicated, and the same information could be gotten just as quickly from the reference manual. However, HELP was updated more frequently than the reference manual, which made it valuable for assistance with newly introduced commands.

(5) The LESSONS/EXERCISES were not very well received, principally because they were verbose. The concept is good, but a more concise approach needs to be taken. However, the exercises were appreciated, and there were several comments that there should be more of them, especially in the later lessons which address more sophisticated system use.

(6) In training a new user, a balance must be struck between formal classes and self-teaching using both on-line and off-line material. Refresher training should be made available for those who use the system intermittently. A strong effort must be made to inform users of new system features, instructions, or procedures. Much training can be done by a student's office mates; however, this presents the possibility of bad habits and poor practices being passed along.

b. Editing.

(1) The editing of various fields of an In-Preparation message was straightforward and simple. The precedence field was set to ROUTINE by SIGMA when the initial In-Preparation AUTODIN message form was displayed to the user. This could lead to the user's overlooking the precedence field if he were in a hurry, resulting in a message being transmitted with a ROUTINE precedence when it should have been FLASH. For this particular field, it would be better to make the precedence a parameter of the CREATE instruction or to draw the user's attention to the field with a prompt of some nature. This also applies to the READDRESS instruction, in which SIGMA established the readdressal precedence as ROUTINE, regardless of the precedence of the original message.

(2) Editing of text was easy, but there were certain editing capabilities that would have made drafting simpler, e.g., a capability for varying the line spacing so that a draft could be double spaced without having to physically remove the carriage returns for the final version, or a capability to capitalize large blocks of text. Many users had trouble with SIGMA's formatting procedures, although a modification permitting the user to delimit the text he wanted formatted was a substantial improvement.

(3) A user capability for editing objects suct as Directories and Files (to control access, for example) would have been useful. A very desirable capability would be user editing of Selectors. Some users had selectors of considerable length, and it became time-consuming to re-do the entire selector when desiring to delete a particular specification.

c. Office/Individual Identification. The major problem for most users was not the double log-on requirement (although a few complained about it), but rather that SIGMA would not let a user who was logged on as an office code and identified as himself get at messages (e.g., For-Chop) in his own Mypending file. The restrictions placed on users by SIGMA

were very vexing to many. At the minimum, every user should be able to have GET privileges on his office code objects, e.g., all personnel assigned to J342 should be able to get any J342 object while logged on as an individual (unless a particular object had specifically been restricted). This could be expanded further upward, e.g., J342 could GET any J34 object, etc. Every user should be able to access and work with all entries in his personal objects at any time, as long as he was properly identified to the system.

d. Experimental Nature of System. The fact that the system was primarily an experiment and not fully operational seemed to escape many of the users, who became irate when the system was down for various reasons. Their reaction is not unjustified, as their participation in the MME caused an extra workload and at times resulted in having to restart work which was almost completed. Every effort was made to keep the system available to the user and to announce scheduled downtime well in advance. However, the experimental nature of the system permitted, and often encouraged, user feedback of great value to the system designers. Many system enhancements were implemented at user request, such as ROUTE, SORT (a file by DTG), controlled formatting, etc., and were greatly appreciated.

e. Internal Messages. SIGMA's capabilities for passing informal notes and formal CINCPAC memoranda were useful but not essential. The telephone or a personal visit (depending on the distance between offices) were equally satisfactory for informal discussions. There was rarely any requirement for memos to be created and delivered at electronic speed; editing and re-writes are equally easy on various word-processing machines. If the MME had extended to other sites outside of CINCPAC HQ, the capabilities for notes might have been much more appreciated, especially if the material under discussion were classified. A desirable feature would be a direct link between terminals, rather than the processing of notes as such. An advantage to the use of SIGMA notes is the keeping of an accurate record of what was said. If the capability for notes and memos can be included in an automatic message-handling system without significant cost in funding and/or system performance, it could save funds that would otherwise be spent on word-processing equipment.

f. Message Distribution.

(1) The ultimate goal in message distribution should be automated distribution to a particular office code or individual, based on a user pre-defined set of criteria. The SIGMA selector attributes (DTG, originator, subject, etc.) are a good start in this direction. If the automated system sent each message to a user's Pending File based on the user's criteria, it would save a great amount of effort that was expended by J301 during the MME in distributing messages. This could be done on a message-by-message basis or when the user logs on. Ideally, the automated system would make a full text search to determine any match with a list of user-supplied keywords, as well as using other message parameters (subject, originator, etc.).

(2) The automated system should be able to assign Action or Cognizance to a particular office code, based on user pre-determined criteria. All criteria used for message distribution should be interactively modifiable by the user, with appropriate control on modifying the Action/Cognizance assignment criteria.

(3) The user should also be able to "pull" messages from a particular file or files, based on a set of user-specified criteria, as well as having the system "push" messages to him as described above.

(4) The system should be able to send messages for which it cannot identify an Action/Cognizance assignment, or any internal addressee, to a service position for resolution.

(5) As mentioned previously, the loose format standards of the current military message make it more difficult for an automated system to accomplish the above in a reasonable manner. Requiring message creators to specify a SUBJECT line, a list of KEYWORDS contained in the message, or the office code of the intended receiver, as examples, would greatly assist the automated system designer in this area.

g. Message Coordination. The Coordinate function as implemented by SIGMA was usable but requires simplification. This is one of the areas which caused a great deal of user dissatisfaction. Release 2.2, implemented in January 1979, greatly improved the Coordinate function, but it still remained complicated and hard for some to understand. There were a number of factors that caused user unhappiness with the automated coordination cycle: coordinator not on the system; coordinator not logged on; key references not on-line; only one on-line reference viewable at a time; face-to-face meeting needed with coordinator due to complexity or controversiality of message; too many versions of the message; and difficulty in rapidly determining the chop status of each coordinator. Some of these problems could be solved by development of better operational procedures to integrate the manual and automated systems. Face-to-face coordination will always be required on some messages, but this does not prevent the initial transmission of the message to the coordinator via the automated system, nor does it preclude the message being displayed during the face-to-face session and coordinated, edited, or released at the end of the meeting. The status of each coordinator's chop could be displayed on the drafter's citation (file entry) as well as in the message, so that he can readily determine chop status without having to display or view the message and get to the chop field at its bottom. Having only two versions of the message (the drafter's original and one other on which each coordinator could make changes/comments) would simplify the drafter's problems in having to refer to so many different versions when there are a large number of coordinators. Automated coordination becomes more valuable as the distance between the drafter and coordinator increases, especially if coordination with another headquarters is required.

h. Access Control. Some aspects of access control have been discussed in paragraph c above. With the exception of certain required restrictions on particular messages or categories of messages (LIMDIS, SPECAT, EYES ONLY, SIOP, etc), there may not be a requirement to prevent access to most messages. If an action officer has a project partly completed and becomes ill or otherwise is not available, another officer will have to assume responsibility for the project. If all the original action officer's work and references are non-accessible to anyone else, the substitute will have a difficult if not impossible task in completing the project. Since a file consists only of pointers to messages, there should be no need to restrict access to it unless the information contained in the File Entry itself required protection. Likewise, Selectors contain only system attributes, so there should be no need to restrict access to a Selector unless a particular subject or originator required protection. Text objects can be kept private by creating them in an individual's rather than an office account. If it were deemed necessary to have restricted access to an object or comment, the default should be PUBLIC, perhaps with a prompt to ensure the user understands the access specification.

i. Role of Paper. It is mandatory to have a printing capability as a part of an AMHS. There will always be situations in which paper copies of messages are required. High-level executives may not desire to have a terminal in their offices or to use a CRT. There will almost always be someone who doesn't have a terminal and with whom a message must be coordinated. Many persons find it easier to read incoming messages on paper copy, as previously discussed; incoming messages may be electronically routed to the appropriate office and readboards of key messages made with paper copies. After entering text into an In Preparation message, it can be much easier to make revisions on a paper copy and then enter them on the terminal, especially if it is a long message. If the AMHS is such that each action officer does not have ready access to a terminal, he might want to keep paper copies of messages with current interest. There will undoubtedly be a requirement for a back-up paper filing system so that messages will be available in the unlikely event of a catastrophic system failure.

j. Archiving.

(1) The 30-day on-line retention of most messages seemed to be satisfactory and was far better than the 15-day retention period prior to the installation of the dual-density disc drives. Users should be given the option of marking messages or text objects for on-line retention after the normal time had come for archiving them; this would need to be controlled closely to prevent abuse, with periodic reminders given to users to check their files for messages no longer needed on-line.

(2) The speed with which a user wants an archived message retrieved varies from instantaneously to "whenever is convenient." A reasonable time would be 5-10 minutes. Users could help the system operator by being able to specify in the retrieval request how rapidly they need the message, e.g., immediately, one hour, tomorrow, etc.

(3) Date files should be kept for at least one year and longer if file space permits. Users should be able to search over a range of dates when looking for a particular message.

(4) The user should be able to control the archiving of personal files and text objects, again with appropriate controls to guard against a build-up of unneeded objects in the system's on-line storage. There would be some files that a user would have continual need for, although the message content might be continually changing. Other files that pertain to a particular event could be archived shortly after the event's completion. The user should be able to specify files and text objects for archive.

k. Critical mass of users.

(1) One of the major problems with the MME, as it was set up, was the small number of terminals that could be supported with satisfactory system response, and thus the number of J3 offices that participated in the experiment. No other CINCPAC staff directorates participated in the experiment. Many outgoing messages needed to be coordinated with non-participating offices; this meant that coordination had to be accomplished both on the MME and manually. If an automated system is to be useful to a headquarters, it must be available to all offices that are participants in the message-handling chain and have enough terminals in each office so that action officers, secretaries, unit chiefs, etc. can have access to the system in a reasonable amount of time. It is not necessary that every action officer have his own terminal, but there probably should be one terminal for every two action officers, and certainly one terminal for every three action officers. Each office's workload should dictate the number of terminals required for that office. Another possible method of terminal distribution would be to have terminals at the branch level and higher, operated by a clerk or secretary. All output for action officers, branch chiefs, etc. would be entered by the terminal operator. The principal advantage of this method of terminal distribution and system use would be a reduction in the required number of terminals. However, this method would lose much of the benefits that accrue from the interactive features of an automated system to which all users have ready access, such as not having to wait for the terminal operator to finish several other jobs prior to doing yours.

(2) It is not necessary that an action officer or office keep the terminal on all the time. If a user has a message to coordinate, he can easily call the office with which the message is to be coordinated and advise that there is a message for coordination. The System Status feature and Alert-Selector feature of SIGMA provide excellent assistance to the drafter and the coordinator in the coordination process.

l. Audit Trail. Not many users were aware of the detail in which SIGMA recorded system and user activity; if they were aware of it, it did not inhibit their use of the system. As mentioned previously, there is not much emphasis on privacy in a military headquarters, except for

specific categories of messages. The documentation provided by SIGMA could be useful to both system designers and to the training cadre, who could analyze a user's style of operation and recommend more efficient ways of system use.

m. User View of System. Most users found the system easy to learn and use. The concept of the response line to tell users what the system was doing or not doing is good. The English language command words and syntax were straightforward, and the system's capability to expand instructions and correct spelling usually helpful; at times, however, the system would interpret a partially entered command differently from the way the user had expected. The system's interpretation of commands based on the situation at the time the command was issued caused some minor difficulties. The concept of opening and closing objects bothered some users who wanted to have more than one of the same kind of object open at a time, so that the user could SHOW an object rather than having to DISPLAY it (SHOW operated much faster than DISPLAY). This would make it easier to refer to several messages when drafting an outgoing message. Two major beneficial features of the system were the capabilities for allowing the user to recover from mistakes easily and for making it difficult to delete an object erroneously by requiring confirmation of any command to do so.

5. Recommendations. The recommendations concerning future automated message-handling systems made in the CINCPAC section of the Mid-Experiment Report remain valid. The following points are reiterated:

a. An automated system must be reliable, readily available to all who need to use it, responsive, compatible with other message-handling equipment, and interoperable with its support message-transmission system.

b. It must be designed and fielded with the close participation of the user community.

c. The benefits to be realized from an automated message-handling system are not of such overriding operational significance as to require the fielding of an interim system that does not meet the user's needs.